Sandia National Laboratories

Environmental Program

Geomechanics Department

Focus

The Geomechanics Department addresses cross-cutting issues in the geosciences and geoengineering related to rock mass characterization, rock mass mechanics, development of numerical codes and numerical simulations, validation of material models and design procedures, and rock mass site monitoring. Supported by combinations of laboratory work and in situ observations, the Geomechanics Department emphasizes:

Characterization of natural fracture systems.

Identification/modeling of rock deformation and failure processes.

Laboratory determinations of thermomechanical and transport properties of competent rock and natural fractures, including studies of coupled effects.

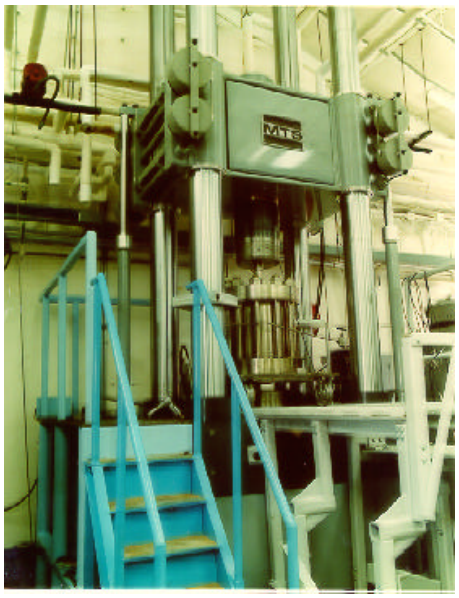
Extrapolation of laboratory measurements to field conditions.

In situ stress measurements and evaluation of in situ boundary conditions.

Laboratory and bench-scale validation studies.

Jointed Rock Mass

Laboratory Facilities



Load Frame and Pressure Vessel

- 0.1-5 MN servocontrolled testing machines
- 1 MN/10 kN-M normal load/torsion testing machine
- 70 MPa - 1 GPa pressure vessels (15 cm maximum cavity diameter)
- True triaxial testing capability
- Hopkinson/Kolsky bar for intermediate rate testing (2.5 cm sample diameter)
- Triaxial creep apparatus (10^{-10} s^{-1} strain-rate resolution)
- Elevated temperature testing to 400°C
- Permeability apparatus with hydrostatic and deviatoric loading capabilities
- Non-destructive testing facilities including real-time acoustic emissions location system
- Laser surface profiler (10 nm resolution)
- Petrographic laboratory
- Specialty machining and sample preparation facilities

Sandia National Laboratories • Geoscience & Geotechnology Center

P.O. Box 5800, Albuquerque, NM 87185-0751

Attention: L. S. Costin, Manager, Geomechanics Department

Phone 505/844-3367 - Fax: 505/844-7354

e-mail: lscosti@sandia.gov

Selected Projects

Shear Strain Localization and Evolution of Fracture Systems in Rock: Study of shear localization and factors favoring localization (inhomogeneities, anisotropy, and yield-surface corners) under axisymmetric and true three-dimensional stress states (sponsor: Defense Programs/Advanced Concepts and Office of Basic Energy Sciences).

Consolidation of Simulated Waste and Crushed Rock Salt: Experimental studies and modeling of compaction, consolidation, and strength of simulated TRU waste components, buffer materials, and crushed rock salt backfill (sponsor: Waste Isolation Pilot Plant Project).

High-Temperature Laboratory Creep Data for Special Concretes: Experimental studies and modeling of creep and relaxation in concrete at temperatures up to 200°C for applications to repository design (sponsor: Yucca Mountain Project).

Flow in Fractured Rock: Determination and modeling of the relationships between fluid permeability and imposed stresses for single fractures (sponsor: Yucca Mountain Project).

Thin-Walled Rock Cylinder Before Torsion Test Under Pressure

In Situ Rock Mass Characterization: Use of active and passive ultrasonic transducer arrays to study the development of disturbed zone around openings in salt (sponsor: Waste Isolation Pilot Plant Project).

In Situ Geomechanics Testing: Design and implementation of large-scale in situ thermal/mechanical tests to study the thermal, hydrological, and mechanical behavior of rock mass under thermal loading (sponsor: Yucca Mountain Project).

Thermal Properties of Rocks and Ceramics: Laboratory determination of thermal expansion and thermal conductivity of intact rock and other materials for modeling response under large temperature changes (sponsor: Yucca Mountain Project).

Material Behavior Under Impulsive Loading: Study of rock response under dynamic loading, especially near the transition from stress-corrosion dominated crack propagation to kinetic-effects dominated cracking, for application in drilling, blasting, and penetration problems (sponsor: DOE Defense Programs).

Characterization of Brittle Materials: Study of the response of brittle materials including plastics, epoxies, and ceramics for electronics and other applications to determine their constitutive behavior and fracture characteristics under multi-axial loading (sponsor: DOE Defense Programs).

Mechanics of Powder Compaction for Ceramic Production: Laboratory determination of the mechanical behavior of ceramic powders and development of models to simulate pressing of ceramic components. (sponsor: American Association of Ceramic Components Manufacturers).

Microgeometry of Porous Media: Application of Scanning Laser Confocal Microscopy to develop three-dimensional representations of the pore structure in insulating materials and development of computational algoriths to quantify statistical microgeometry (sponsor: Laboratory Directed Research and Development Program, Office of Basic Energy Sciences, and NASA).

Installation of Single Heater Test at Yucca Mountain

Geomechanics of Reservoir Management: Sandia/industry program concerning the effect of in situ stress and production-induced stress changes on mechanical and fluid-flow properties of reservoir rocks and natural fractures (sponsor: Office of Oil & Gas Exploration and Production).

Simulation of Reservoir Response: Development and application of numerical modeling techniques to simulate coupled mechanical-fluid transport effects in oil and gas reservoirs with the aim of providing tools for better

management of the recovery process. (sponsors: Office of Oil & Gas Exploration and Production and Oil Technology Partnership). *Rock Blasting Computer Simulations:* Modeling of rock fragmentation and blasting-induced rock motion by means of special-purpose discrete element computer code (sponsor: ICI Explosives, Inc.)

Development and Demonstration of Alternative Landfill Covers: Development of landfill cover concepts and field demonstrations using capillary barriers and other techniques to address the unique problems of landfills in arid environments (sponsor: Office of Environmental Management).